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HOW-TO GUIDE

Virtualizing an IT Infrastructure with Confidence

A Guide to Planning and Implementing a Linux*-based Virtualization Project

For many organizations the benefits of virtualization are so persuasive that the question is no longer "Do we do it?"

It is now "How and when do we do it?"

If virtualization seems right for your organization, you may be looking for answers to some basic questions before starting down this path. For instance, if you are considering a move to an open-source solution to take advantage of cost and efficiency benefits, you may be wondering if such a solution will allow you to virtualize your legacy Microsoft Windows* systems and applications.

This guide shows how to take your data center from an existing traditional IT environment to a Linux*-based virtualized IT infrastructure that supports both Windows* and Linux applications, while gaining compelling virtualization benefits such as:

- **Increased flexibility** that lets you use data center computing resources more efficiently while minimizing hardware investments in a virtualized IT infrastructure that supports both Windows* and Linux workloads.
- **Simplified management** with tools that let you effectively manage the complexity of a virtualized environment while decreasing support costs, enhancing security, and increasing agility.
- **Reduced risk** with a virtualized IT infrastructure that lets you maintain security and stability while supporting failover, backup, and business continuity systems.
- **Increased cost savings** in capital expenditures through consolidation of workloads on fewer servers, and lower operating costs through reduced energy use, less demand on facilities, and simplified management and maintenance.

How do you sort through the myriad of possibilities to find the solution that best fits your company's situation? Let's look first at how virtualization is achieved and what the implications are for your workload requirements and legacy applications.

A Flexible Virtualization Solution with Near-Native Performance

Paravirtualization is one of several virtualization solutions in which underlying computer hardware is emulated in virtualization software mediated by a hypervisor. The hypervisor runs on the host operating system and enables guest operating systems of various types to run on virtual machines, all of which are running on the same physical machine.

Paravirtualization offers exceptional performance that approaches that of applications running directly on the host operating system. Because some of the hypervisor's overhead is off-loaded onto the guest operating systems, near-native performance for workloads on virtual machines becomes possible.

Most paravirtualization solutions, however, require that each guest operating system be modified to enable it to work with the hypervisor. Modifying an open-source operating system adds an extra step, but it can be done. However, this requirement becomes a roadblock for a proprietary operating system like Windows, which can't be changed.

Paravirtualized network, block, and bus device drivers, like those offered in the SUSE® Linux Enterprise Virtual Machine Driver Pack, allow fully virtualized operating system instances to achieve paravirtualized performance levels, without the need to modify the operating system[1]—enabling exceptional performance levels with Windows as well as Linux workloads.

Xen* 3.0 is an open-source virtualization solution with a hypervisor that supports paravirtualization of unmodified guest operating systems, including Windows XP* and Windows 2003 Server*. The Xen 3.0 hypervisor uses features of Intel® Virtualization Technology (Intel® VT) to achieve this capability, which significantly reduces hypervisor overhead and enables near-native performance for unmodified operating systems[1]. Intel VT is available on servers with Multi-Core Intel® processors.

Five Key Components of a Linux-based Virtualization Solution

A good first step is to take a look at the key components of a virtualized solution. You'll want to understand the technology tradeoffs and options for an optimum solution for your organization. For a solution based on Linux that lets you virtualize your legacy Windows systems and applications, look for these five key components:

1. **Stable, reliable Linux operation system.** Look for the proven performance and robust reliability that you would want in any operating system. In addition, check for features that support virtualization for all your workloads.

   For example, the SUSE Linux Enterprise 10 Service Pack 1 (SP1) operating system from Novell is an enterprise-grade Linux solution that comes with a built-in Xen 3.0 hypervisor. It supports virtualization of Windows-based workloads on servers with Intel VT without sacrificing performance, security, or reliability.

2. **High performance virtualization technology.** Look for a virtualization solution that allows you to run unmodified Windows and Linux workloads at near-native performance levels. Such a capability extends the useful life of legacy and custom applications that are supported only on older operating systems and lets you run them on newer, more powerful energy-efficient hardware.

   A solution to consider is the Xen hypervisor technology integrated into SUSE Linux Enterprise Server 10 (SP1) with the optional SUSE Linux Enterprise Virtual Machine Driver Pack from Novell. The SUSE Linux Enterprise Virtual Machine Driver Pack is a bundle of paravirtualized network, bus, and block device drivers that enable unmodified Linux and Windows guest operating systems to run with near native performance in Xen virtual environments.[1] These drivers are optimized for Intel dual- and quad-core processors so they provide exceptional performance for both Windows and Linux workloads. They have been tested and certified as interoperable with Linux and Windows.

3. **Servers optimized for virtualization.** Even though your organization is moving to a virtualized environment, you will want to build the virtualized environment on the right physical infrastructure. Servers with built-in virtualization capabilities can provide an "assist" to the other components of the solution. Also, Multi-Core Intel processor-based servers can improve consolidation ratios while reducing operating costs. Performance, availability, scalability, and energy use are still important requisites to take into account as well.

   A virtualized environment based on IBM System x™ and BladeCenter® servers provides the outstanding performance, availability, and scalability you expect from IBM and Intel. These servers use the latest Dual-Core and Quad-Core Intel Xeon processors to deliver industry-leading performance and unsurpassed efficiency for Linux applications with multi-core scalability.

   The results of a study conducted by Intel IT[2] to explore the potential of consolidating and virtualizing processor-intensive applications on the Quad-Core Intel Xeon processor 5300 series showed that each 8:1 server consolidation could save about USD 6,024 a year in direct operating costs, based on support, network depreciation, and power and cooling.

4. **Sophisticated management capabilities.** Look for features and tools that reduce management complexity, lower costs, and increase agility by enabling IT staff to:

   - Discover, visualize, and manage multiple physical and virtual systems from a single console, including both Linux and Windows servers.
   - Analyze server performance and availability and optimize resource configurations.
   - Monitor power being consumed by servers to optimize the environment for more efficient power usage.

Also consider advanced virtualization features such as virtual symmetric multiprocessing, which allows a single virtual machine to use several physical processors simultaneously—an important feature for scaling a virtual infrastructure.

The IBM Systems Director platform management family supports these functions through robust management capabilities that enhance control over the environment, helping to lower costs and increase IT agility. IBM Systems Director tools help maximize availability by allowing administrators to track system configurations and manage the utilization of system components such as processor, memory, and hard disks. This capability is enhanced by simple-to-use, fully integrated extensions:

- **IBM Virtualization Manager** allows discovery, visualization, and management of both physical and virtual systems from a single console. Proactive virtual machine migration based on predictive alerting helps avoid downtime.
- **IBM PowerExecutive**™ allows direct monitoring of the power being consumed by server hardware, helping administrators optimize the environment for more efficient use of power resources.

The IBM Systems Director platform management family is provided with IBM System x and BladeCenter servers at no additional charge.

5. Enterprise-based support. To help you maximize your investment in a virtualized IT infrastructure, look for comprehensive, reliable, enterprise-class software and hardware support that spans your Linux operating system, virtualization technology, and hardware platforms.

When you choose a Xen-based virtualization solution based on SUSE Linux Enterprise Server 10 (SP1) running on IBM System x and BladeCenter servers, you will have access to two of the industry's leading support organizations. Novell and IBM will be there to help you walk through your virtualization deployment and continue to offer their world-class expertise as long as you need it.

Novell offers a wide range of professional support services, including Linux support, training, and consulting, and full support for the Xen hypervisor integrated into SUSE Linux Enterprise Server 10 (SP1). IBM provides comprehensive hardware and software support for your Multi-Core Intel processor-based server environment as well as support for IBM Director, Windows, Linux and the Xen hypervisor on IBM System x and BladeCenter servers.

How-to Guide to Implementing a Virtualized IT Environment

So where do you go from here? Typically you will proceed through several phases as you plan, design, and implement your virtualized environment.

1. Take Stock—Make an Initial Assessment

First, simply stand back and take stock. To help you determine if it makes sense for your company to proceed, you'll need to understand the benefits virtualization will bring to your organization and the costs of implementing a solution.

- **Which benefits of virtualization are most important to your company?** Do you need to:
  - Maximize performance by implementing a virtualization solution on multi-core servers with built-in virtualization technology?
  - Consolidate hardware to reduce capital expenses and demands on data centers for more space and power?
  - Reduce application downtime for scheduled maintenance tasks to maximize computing resource availability?
  - Simplify IT management for lower administration and maintenance costs?
  - Increase flexibility and agility to meet current and future business needs?
  - Support a mixed Windows and Linux environment with a single management console?

  Once you understand your priorities, you'll be able to make astute and effective trade-offs as you proceed down the path of virtualization. For example, hardware costs may be reduced through server consolidation but at the cost of adding a new layer to your IT environment. You will need to factor in other expenses as well, such as costs for virtualization software, deployment, and staff training.

  Understanding benefit priorities and cost trade-offs will help you present to stakeholders and managers a business case for virtualization that will help you obtain buy-in and support while setting reasonable expectations.
- **What factors can affect the cost of virtualizing?** Take into account both the potential costs to implement your virtualization solution and the potential costs to maintain it. Transition costs may include:
  - **Software costs** including components of the solution, such as virtual machine drivers, management tools, and operating system upgrades.
  - **Hardware costs** to optimize the virtualization solution, such as new servers, storage expansion, or network enhancements.
  - **Resource costs**, such as training for staff or consulting fees.

Ongoing costs may include:

- **Additional licensing costs.** For example, a licensing policy based on the number of processor cores may result in higher costs when you move an application to a multi-core processor even if the application uses just one or two cores.
- **Increased demand for licenses.** Virtualized applications can expand access to new users who will need licenses.
- **Policy-related costs.** Sometimes IT staff budgets are tied to the number of existing physical servers. You may need to quantify how the tasks and time needed to support physical servers translates to support for the same or fewer virtual servers.

2. Set the Stage—Develop a Virtualization Plan

Careful planning pays off for any complex endeavor. Take a look at not only the design and implementation of your virtualized IT infrastructure, but also at scheduling, training, and policies and procedures to support it once it's up and running.

- **Determine the ratio of virtual to physical servers your current infrastructure can support.** This will tell you where you need to invest to optimize your virtualization environment. Consider available CPU cycles and also look at limits that may be imposed by:
  - Storage space and disk I/O
  - Available memory
  - Network bandwidth
- **Determine which workloads to move to a virtualized environment.** Not all servers or applications may be suitable for virtualization. Some vendors provide assessment tools that can help with this step.
- **Select hardware and software.** The section *Five Key Components of a Linux-based Solution* described several considerations for selecting hardware and software for a virtualization solution. To simplify implementation and get your virtualized environment up and running quickly, consider deploying a software solution stack that has been pre-validated on industry-standard server hardware.
- **Build a roadmap for implementation.** Consider these options:
  - Begin your deployment in low risk areas such as test or development. Then move to new applications that have been developed and tested for a virtualized environment. Finally, move to higher risk areas and older applications.
  - Schedule around periods of heavy usage.
  - Identify server upgrades critical for initial deployment. Then plan to phase in tertiary hardware over time as growth demands.
- **Create a staff training plan.** Your IT staff will need new skills to support and manage your new virtualized environment, including skills in problem diagnosing, configuration management, and capacity planning.
- **Establish internal policies and procedures.** You'll need policies and procedures for creating, configuring, and maintaining virtual processors, and, eventually, removing obsolete virtual processors. Effective policies and procedures will help keep your virtual environment stable and secure and help you realize cost savings by avoiding virtual processor sprawl.

3. Move Forward—Prepare for a Successful Deployment

As you prepare for deployment, you'll want to establish a migration plan, put a test plan in place, and, ultimately, establish benchmarks to use going forward.

- **Develop a migration plan.** Plan how you will move applications and servers from physical machines to virtual machines. Identify the patches and updates needed for a successful migration. Isolate potential driver and hardware incompatibilities.
- **Implement a comprehensive test plan.** It's best to test virtual machine configurations under actual performance conditions. Take it a step at a time by integrating your test plan with your implementation roadmap and starting with low risk areas before moving to more complex areas of implementation.
- **Establish benchmarks.** Establish performance and usage metrics to help you monitor performance and evaluate enhancements going forward.

With a thorough assessment, solid planning, and careful preparation, you will be well-equipped to embark on the path to virtualization for your organization.

Launching Your Virtualization Project

Extend the value of virtualization to your organization, while helping protect your legacy software investments, with a cost-effective server consolidation solution that takes advantage of the world-class products and long-standing engineering expertise of Novell, IBM, and Intel.

Begin with a total cost of ownership (TCO) analysis. A no-charge server consolidation TCO analysis may be available separately through select IBM Business Partners for qualified customers. Ask your IBM Business Partner or visit **www.virtualizationsolution.com** for more details.

Reduce deployment risk and complexity. Take advantage of a certified software and hardware solution with the integrated, Xen-based virtualization solution offered by Novell, IBM, and Intel. This solution is tested and certified for both Linux and Windows workloads. Optional paravirtualized drivers from Novell provide near-native performance levels[1] for virtualized Windows[3] and Linux[4] applications.

Increase your cost savings. The integration of the Xen hypervisor into SUSE Linux Enterprise Server 10 (SP1) eliminates the need to purchase additional virtualization software, making the overall solution cost competitive with that of other solutions. More importantly, the solution's high performance allows very high consolidation ratios that reduce ongoing total cost of ownership.[2]

Support costs are lower because there are fewer machines to maintain, and management is streamlined with the IBM Systems Director platform management family. In addition, the high energy efficiency of Intel processor-based IBM System x and BladeCenter servers means reduced power is required per watt, so data centers not only become easier to keep cool, but server sprawl becomes a thing of the past.

Deploy with confidence. This integrated solution stack provides state-of-the-art results at a competitive price and includes comprehensive, enterprise-class solution support from IBM with support for the optional SUSE Linux Enterprise Virtual Machine Driver Pack from Novell. The program extends the value of virtualization to your organization while protecting your legacy software investments, allowing you to run both Windows and Linux workloads in a reliable, secure virtualized environment with near-native performance.[1]

Get started now. Novell, IBM, and Intel have done the work for you. To find out more about how this solution can enhance your data center operations, visit **www.virtualizationsolution.com**.

FOR MORE INFORMATION

Visit **www.virtualizationsolution.com** for more information about:

- Virtualization enabled by Novell, IBM, and Intel.
- A no-charge server consolidation TCO analysis available through select IBM Business Partners for qualified customers. You can also contact your IBM Business Partner for more details.

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[1] Internal and pilot Novell testing with the SUSE Linux Enterprise Virtual Machine Driver Pack has shown that networking throughput is approximately 90 percent to 100 percent of native networking throughput, and disk I/O is 80 percent to 90 percent of native disk I/O.

[2] **www.intel.com/it/pdf/consolidate-using-quadcore.pdf**

[3] The Driver Pack contains paravirtualized network, bus, and block device drivers for Windows Server 2003 (32-bit and 64-bit), Windows 2000 (32-bit), and Windows XP (32-bit and 64-bit).

[4] Paravirtualized device drivers for Red Hat Enterprise Linux 4 and Red Hat* Enterprise Linux 5 will also be available in the second half of 2007; they will be delivered as free updates to the Virtual Machine Driver Pack via the Novell Customer Center.

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